

THE
Malayan Agricultural Journal.

Vol. XIV.]

JULY, 1926.

[No. 7.]

OBITUARY.

With deep regret we have to record the death of Che Din bin Mat, Junior Agricultural Assistant, Krian, which occurred at Bukit Tambun in Province Wellesley on 28th June, 1926.

Che Din was a conscientious, painstaking officer who joined the Agricultural Department in June, 1918. His examination record as a Probationer was distinctly good, and for the last three years as local officer-in-charge of field work in Krian he worked strenuously under the trying conditions which padi work involves. He conducted numerous demonstrations each harvest to local as well as to visiting Malays from various States, and will long be remembered as a valuable officer who spared no effort to benefit padi cultivators.

OBSERVATIONS ON THE BETEL-NUT PALM (ARECA CATECHU, L.) AND BETEL-NUTS.

W. N. SANDS.

AS the outlook for the future appeared to indicate that the cultivation of the betel-nut palm offered scope for profitable planting enterprise, information has been sought by prospective planters as to (a) the best variety or varieties to plant; (b) the relative values of the different varieties from a market standpoint; and (c) the most desirable method or methods of preparing the nuts for export.

As far as could be ascertained there was no local literature available concerning the first two questions. On the other hand, the cultivation of the palm together with the local methods of curing the nuts have been fairly fully described in a general manner by Stirrup (1) and Flippance (2).

ORIGIN AND HISTORY.

The original habitat of the betel-nut is unknown but Beccari (3) considers that a Philippine variety, *Areca Catechu var silvatica*, possibly represents the true wild plant of that widely cultivated species; for in the Philippines, various forms of *Areca* occur so closely related to *A. Catechu* as to afford good ground for belief that it was in those islands that *A. Catechu* finally assumed the specific characters it now exhibits. In support of this opinion he observes that in no other part of Southern and Eastern Asia or Malaya is any species of *Areca* to be found which in any way approaches *A. Catechu* in specific characters, whereas in the Philippines an entire group of species exists closely related to it.

Ridley (4) states that he had never seen the palm in a wild condition in Malaya nor did it appear to establish itself outside cultivated ground. He mentions that it was cultivated in Malacca before 1593, as it is referred to by Garcia da Orta in Hist. Arom. 99., published in 1593, and it is mentioned in a Chinese work dated 140 to 80 B.C., under the name Pinlang, which was evidently a perversion of Pinang, which as a name for the tree is confined almost entirely to the Malay Peninsula and Sumatra.

The earliest historic reference by a European to the habit of chewing betel-nut occurs in the writings of Marco Polo (1298 A.D.).

The palm is widely distributed in tropical countries where climatic conditions are suitable for its growth. It has undoubtedly been cultivated locally on quite a large scale for a considerable number of years, more particularly in certain districts of Johore, Malacca and Penang. It is grown in

these places mainly in low-lying coastal districts, but it occurs throughout Malaya where it forms quite a striking feature in most villages and gardens. Further, it is often seen at moderate elevations on mountains, for example, Penang Hill, where the palm fruits fairly well at a height of 2,400 feet; but it is undoubtedly in the hot, moist, rich alluvial areas near the coast that it is seen at its best.

USES.

The nut is used chiefly as a masticatory by people of Eastern races, and with the natural increase in population the demand for the nut is steadily growing. To the taste the nut is astringent and slightly acid; it possesses also narcotic and anthelmintic properties. These properties are due mainly to the alkaloid *Arecoline*, but three other closely allied alkaloids have been isolated. The alkaloids are said to occur in the light-coloured endosperm and not in the dark-brown or red portions which contain the colouring matter.

For chewing purposes a small portion of the fresh or dried nut is taken and wrapped in a piece of leaf of the betel vine (*Piper Betle*, L.) together with a little lime. In addition, there may be added, according to taste, gambier, tobacco, cloves, cardamons or 'kossa' (*Catechu*).

The powdered nut owing to its astringent action on the gums is used as a dentrifice, and in veterinary practice for the expulsion of 'worms' in animals.

A decoction of the nut yields an inferior resinous extract known as *Areca Catechu* or *Kossa*. The nut is also used in the production of dyes and tanning materials, but the quantity used for these and other purposes is small.

As the most important use of, and demand for, the nut is for masticatory purposes, information concerning the different grades of nut has been sought from local merchants who dealt largely in the dried product for export to India and Burma; whilst investigations concerning the varieties producing nuts which were likely to prove most suitable for the export trade have been made in different districts.

At the outset it may perhaps be useful to give a description of the vegetative, flowering and fruiting characters of the Palm some of which are of considerable interest and importance from a planting standpoint.

VEGETATIVE CHARACTERS.

Areca Catechu is a graceful tall-stemmed palm often reaching a height of 60 feet. Its stem is cylindrical, 5 to 8 inches in diameter, and ringed distinctively from the base upwards by the scars of the fallen leaves. The stem is green when young, but assumes a greyish colour with age; it is slender in comparison with its height, but being tough and

strong it is not readily broken by the wind, and further it is able to maintain itself in an erect position even in fairly soft soils by means of numerous strong roots which grow out above the base of the stem as well as below in the soil. The crown of leaves is compact with a diameter of about 8 feet. The leaves are pinnate from 4 to 6 feet long, with a long sheathing base which completely encircles the stem. The leaflets are numerous, 1 to 2 feet long and 1 to $1\frac{1}{4}$ inches wide, some of which may remain joined together; they are fairly rigid and form a somewhat dense, flattish surface.

FLOWERING.

When grown under the best conditions the palm often commences to flower when it is about 4 years old. The first inflorescence to open may occur on the stem at 4 to 6 feet from the ground in the axil of the lowest attached leaf. Each inflorescence or spadix is closely covered by a leaf-sheath until a few days before it is ready to open. Further the spadix is completely enclosed in a sealed, double boat-shaped, flattened spathe about 2 feet long and 7 inches wide in its broadest part. The inner and upper side of the spathe is much thinner and weaker than the lower and outer side, so that the expanding spadix easily bursts the spathe open along its upper side in a central longitudinal line and frees itself.

The spadix is shortly stalked, $1\frac{1}{2}$ to 2 feet long, with numerous branches and unisexual flowers. Each secondary or tertiary branch bears one to several female flowers near its thickened base; whilst an abundance of male flowers are produced on special filiform branches, 6 to 10 inches long, which arise below and extend beyond the female flowers. The male flowers are arranged in pairs in two rows along the upper part of these thin branches, but occasionally one or two of them are found at the base of and beside a female flower.

The male flower is small, $\frac{1}{8}$ inch long, sessile, triangular, white, with three minute sepals and three larger, stiff, lanceolate petals. The stamens number six and contain very minute, colourless, pollen grains. The rudimentary ovary is trifid and slightly longer than the stamens.

The female flower is $\frac{1}{2}$ to $\frac{5}{8}$ inch long, sessile, with three broadly imbricate green sepals about as broad as long and three ovate petals. At the time the flower is receptive the petals are creamy white and about one-third longer than the sepals. There are six minute flattened staminodes whose bases are joined together and encircle the base of the ovary.

The ovary is surmounted by a thick trifid stigma which is situated immediately below the small opening formed at the tip of the flower by the petals.

Both the male and female flowers are very fragrant.

MALE AND FEMALE FLOWERING PHASES.

The male phase begins immediately after the spadix frees itself of the spathe. The male flowers commence to open at the tip of each slender male branch and continue backwards towards its base in a fairly regular manner until all the flowers are exhausted. This phase lasts from three to four weeks.

Near the end of the male phase the green petals of the larger female flowers commence to lengthen and to change their colour. After the last male flowers have opened, the petals of the female flowers open slightly at the top, and soon after, the flowers become receptive and remain so for perhaps two or three days. Although the female phase definitely starts after the close of the male phase, the commencement of it, reckoning from the time of the opening of the flowers, has been found to vary considerably in different trees. In some instances the flowers opened the day following the close of the male phase, whilst in others up to eleven days elapsed before they opened. The average time however was about four days.

The male flowers are visited by various small bees and other insects which appear to collect or feed on the pollen only, but no insect visitors have been seen on the female flowers. It would appear certain that the pollen is carried by the wind to the female flowers which, under the circumstances related above, are normally cross-pollinated and that only under exceptional circumstances can the flowers be pollinated by pollen from the same tree. This is an important point because it shows that much difficulty would be experienced in obtaining pure races of the betel-nut under ordinary conditions; however, it has been observed that young trees when growing rapidly under good conditions sometimes develop spadices in such quick succession that the male phase of the last opened spadix overlaps the female phase of the one immediately below so that self-pollination is possible.

FRUITING.

The fruit takes about eight months to ripen, and when ripe it is orange-yellow or yellow in colour and consists of a thick fibrous outer layer, the pericarp, which encloses a single seed or nut. The seed is inserted considerably above the base of the fruit. The hard endosperm which fills the seed is traversed by dark wavy lines which give it a marbled appearance resembling the nutmeg. The red or reddish brown markings are due to the infolding of a dark inner layer of the seed-coat into the light coloured endosperm. The embryo situated at the base of the seed is

fairly large and conical in shape. The size and shape of the fruits and nuts from different types will be described separately.

Under suitable local conditions the palm is reputed to bear profitable crops for at least 30 years. Watt (5) states that in Bengal the fruiting life of a tree may be put at from 30 to 50 or 60 years after maturity, and the total life of a tree at from 60 to 100 years. In Bombay the palm is known to fruit freely for 30 to 40 years and there is a popular belief that it is sometimes profitable much longer.

In Malaya the palm is in fruit throughout the year; still as in India, the period of largest production is from November to February, which indicates that more rapid growth and flowering takes place in the wet months April to July than in other periods of the year. It is no uncommon sight to see a palm bearing seven or more spadices with flowers and fruit in different stages of development, but the usual number is four or five when in full bearing and three to four or less in old palms. Seven palms, eight years' old, under observation in the Public Gardens, Kuala Lumpur, produced spadices at intervals of 6 to 8 weeks in the period November to May, 1926. An inflorescence every six weeks would give 8.6 per year and every eight weeks 6.5 if this rate of flowering was constant throughout the year which, as already mentioned, is not the case. The number of fruits borne on a spadix is very different in particular varieties and may vary from 50-100 in certain large types to 150-250 or more in some of the medium and small forms.

As all the plantations locally contain numerous types of the palm which vary considerably from each other in many characters such as, for example, length of time before fruiting; number of bunches of fruit produced per annum; number of fruits per bunch; size and shape of seed (nut); it is most difficult to give reliable estimates of yield. Reference however, may be directed to page 226 where this question is discussed.

VARIETIES.

In common with many other species of useful plants that have been cultivated a long time, the betel-nut palm has produced many varieties. Beccari (loc:cit) describes several which occur in the Philippines and similar variations are found in India, Ceylon and other tropical countries. In Malaya there is a wide range of types, many of which have Malay names. Where a rough selection of nuts for planting purposes has been made, the poorer kinds are fewer in number than in districts where no selection has been practised, but in no area locally has even a small plantation been seen where the types were not mixed. On the other hand, pure cultivations are said to exist in Southern India

and to a smaller extent in Ceylon, notably in the Kegalle District.

It should be mentioned here that several other palms besides *Areca Catechu* are termed Pinang by the Malays. One species in particular, *Actinorhytis Calapparia*, Wendl and Drude, the *Pinang penawar*, *P. bali*, *P. hutan* or *P. sembawa* — is frequently found in gardens, and its fruit is commonly exhibited as that of a betel-nut at local agricultural exhibitions. The fruit is striking in appearance, dark-red, large, ovoid, pointed, and its large ovoid seed has ruminate endosperm. The sliced and boiled nut mixed with ginger, pulverized sea-shells and coconut oil is used solely for the manufacture of a liniment termed *Minyak Sembawa*. If chewed in a fresh condition the nut is said to act as a poison.

As observations on the flowering of the betel-nut palm have shown that the flowers are normally cross-pollinated and that in all plantations and gardens there are numerous types, it will be realised that, in the absence of breeding experiments, it is an almost hopeless task endeavouring to decide which of the large number of forms are distinct varieties or races and which are merely unstable hybrids; however, as certain types commonly occur in plantations and have been given names by the Malays, these will be described. They are all used for chewing purposes.

Pinang Wangi or *Fragrant Betel-nut*.—This is the largest local variety. Although somewhat rare, it is well-known to and much sought after by the Malays, who state that it was introduced from the Celebes. It is not a very productive variety and the nut is not considered suitable for export purposes. When chewed in a fresh state the nut has a peculiar aromatic flavour, but it is said to lose this when dried.

The fruit is yellow when ripe, ovoid, about 3 inches long and $2\frac{1}{8}$ inches in diameter in its widest part. The apex is round and slightly depressed. The nut is large, broadly ovoid with a flattish base, slightly longer than broad, measuring when freshly cut $1\frac{1}{2}$ inches long and $1\frac{2}{5}$ inches wide.

A single palm, said to have been grown from a fruit of *P. wangi*, was found at Telok Datoh, Kuala Langat, Selangor, named *P. wangi sali**. The palm produces very large fruit, longish ovoid in shape, $3\frac{1}{2}$ inches long and $2\frac{1}{4}$ inches broad, yellow when ripe. The pericarp is fairly thick. The nut is broadly ovoid, large, $1\frac{7}{10}$ inches long and $1\frac{1}{2}$ inches wide, and has the distinctive flavour of the 'wangi' nut.

* *Sali* is the Malay word for strength or power.

This is an interesting giant form which has not so far been seen elsewhere. It may be a first generation hybrid of the "wangi" variety with some other type, and as such shows hybrid vigour or heterosis.

The different types used for commercial purposes may be roughly placed in two groups, namely, those producing round nuts and those having long nuts. The round types have nuts which are as broad or broader than long, and the long nuts are longer than broad.

ROUND TYPES.

Pinang telor.—Fruit large, about the size of a small hen's egg, globose-ovoid or obovoid about $2\frac{1}{2}$ inches long and $1\frac{3}{4}$ inches wide, reddish-yellow, apex rounded. Pericarp rather thick. Nut large, rounded, flattened at base, $1\frac{1}{4}$ inches x $1\frac{1}{4}$ inches or rather broader than long.

A productive and popular form which closely resembles the Singhalese 'Rata puwak' variety, and a large variety obtained from Madras under the name 'large round'.

Pinang jambu.—Fruit large, the size of a small hen's egg, globose-ovoid or ovoid, about $2\frac{1}{2}$ inches long and $1\frac{3}{4}$ inches wide with a small protuberance at apex, reddish-yellow. Pericarp splits slightly at the apex when the fruit is ripe. Nut large, rounded or slightly pointed, flattened at base, $1\frac{1}{4}$ inches x $1\frac{1}{4}$ inches or slightly longer than broad.

Like *P. telor* this is a common and popular type which in several respects it closely resembles.

Pinang lemak.—Another large 'telor' type, was collected under this name in Johore.

Pinang kuning.—Fruit large, ovoid-ellipsoid, distinct yellow, 3 inches long and 2 inches wide, apex rounded or with a small protuberance. Nut large, rounded or slightly pointed, $1\frac{3}{10}$ inches x $1\frac{3}{10}$ inches or rather longer than broad.

A good productive form. Common in the coastal districts of Johore. Considerable variation was observed in the size of the fruit.

Pinang betel.—Fruit globose-ovoid, medium size, 2 inches long and $1\frac{3}{4}$ inches wide, reddish-yellow. Apex with a rounded protuberance. Nut rounded, $1\frac{1}{8}$ inches long and nearly as broad.

Pinang malan.—This closely resembled *P. betel*, except for a more pronounced protuberance at the apex of the fruit in the specimens seen, but this swollen portion is often variable in size and shape in a particular type. These two forms were obtained in the Batu Pahat District of Johore.

Pinang bonto tabon.—Fruit ovoid or ellipsoid-ovoid, $2\frac{1}{2}$ inches long and $1\frac{3}{4}$ to 2 inches wide. Apex rounded or slightly protuberant. Ripens unevenly from the apex, eventually yellow. Nut rounded, $1\frac{1}{4}$ inches x $1\frac{1}{4}$ inches.

The uneven ripening of the fruit is a distinguishing character of this type which occurs in most of the districts where the nut is grown for export.

Pinang Small Round.—Fruit ovoid, 2 inches long and $1\frac{2}{5}$ inches wide, reddish-yellow with a small rounded protuberance at apex. Pericarp thin. Nut round, 1 inch long and 1 inch wide, or slightly wider than long.

This is a good small-fruited form which was found in the Public Gardens, Kuala Lumpur. It resembles the best small Bengal types.

LONG TYPES.

Pinang ranggong.—Fruit ellipsoid, $2\frac{1}{2}$ inches long and $1\frac{1}{2}$ inches wide, reddish-yellow. Apex rounded. Pericarp thin, $\frac{1}{4}$ inch; thick at side. Nut ovoid-conical with rounded apex and flattened base, $1\frac{1}{2}$ inches long and 1 inch diameter.

This is a common and popular form in some districts,

Pinang seluang.—Fruit narrowly ellipsoid, 3 inches long and $1\frac{2}{5}$ inches broad, reddish-yellow. Apex with a distinct rounded protuberance. Nut much longer than broad, ellipsoid-conical, $1\frac{3}{8}$ inches long and $9/10$ inch broad.

A Philippine variety closely resembling this is described by Beccari (loc:cit) under the name, *Areca Catechu var longicarpa*, and a similar type was obtained from Madras under the name 'long'.

Pinang rambai.—A medium to small-sized long type bearing large bunches of fruit was observed in the Batu Pahat District of Johore under this name, but the name appeared to be quite local. The fruit and nut resemble those of *P. kerdu*, described below.

Pinang kerdu.—Fruit small, ovoid or ovoid-ellipsoid, 2 inches long and $1\frac{1}{4}$ to $1\frac{1}{2}$ inches wide, reddish-yellow. Pericarp thin. Nut ovoid-conical, 1 inch to $1\frac{1}{10}$ inches long and $\frac{3}{8}$ inch wide.

This is a very common form closely resembling the 'Singhala puwak' of Ceylon. It bears heavy crops.

The average sizes of the nuts of the different types are those for nuts taken from ripe fruits. When sun-dried the nuts shrink and are therefore somewhat smaller in the dried product.

INDIAN AND CEYLON VARIETIES.

In order to compare certain of the Indian and Ceylon varieties with the local ones, six varieties were obtained from the Director of Agriculture, Madras, and two from the Curator of the Royal Botanic Gardens, Peradeniya, Ceylon.

Those from Southern India were:—

(1) *Round, big*.—A large globose-ovoid fruit closely resembling the local *Pinang telor*. The nut is roundish, rather broader than long, large, dark-grained, and soft in the centre.

(2) *Round, small*.—A medium-sized fruit, ovoid, pointed. Nut small, round and close dark-grained.

(3) *Convex shaped*.—A fairly large fruit, ellipsoid-ovoid, pointed. Nut large, ovoid-conical, coarse grained, with a large proportion of light coloured endosperm.

This variety has a very distinct type of nut which has not yet been seen locally.

(4) *Pointed Top*.—Medium size, ellipsoid-ovoid, with a distinct acuminate point. Nut fairly large, broadly ovoid-conical, dark-grained.

(5) *Narrow base*.—Small, ellipsoid, distinctly tapering to the base, Nut small, rounded, rather coarse-grained, soft and white.

This variety is said to cause slight giddiness when chewed.

(6) *Long*.—This closely resembles in fruit and nut characters the local *P. seluang*.

The Ceylon varieties were:—

(1) *Rata puwak*.—A type closely resembling the local *P. telor* already described.

(2) *Singhala puwak*.—This is like the Malayan *P. kerdu* in fruit and nut characters.

After examining fruits and nuts of varieties from India, Ceylon, the Dutch East Indies and elsewhere, and comparing them with the local forms, the writer is of opinion that there are already growing in Malaya types equal in productiveness and many other characters which compare favourably with the best varieties of other countries. Unfortunately, as mentioned previously, nothing is known of the genetics of the different forms, and several years must elapse before trustworthy information in regard to this is available. In the meantime, nuts for planting should be taken from individual palms which are known to produce

good crops of the type of nut desired. It would appear certain that the most profitable method of preparing the nuts for market under local conditions will continue to be that known as *Pinang belah* or 'splits', and this being the case, large and medium sized types should be selected from among those described above, as *P. telor*, *P. jambu*, *P. kuning*, *P. lemak*, and *P. ranggong*. There is a doubt as to whether certain of these are really quite distinct types, but in the Batu Pahat District of Johore, where some of the finest local plantations are to be found, *P. jambu*, *P. lemak* and *P. kuning* for example are well-known forms.

No type can be relied on to breed true for the reasons already given, still a larger proportion of palms bearing satisfactory crops of good-sized nuts is likely to be obtained if a selection of fruits from individual trees is made. As will be shown later, local buyers of the produce do not, at the present time, pay a lower price, at any rate in the case of 'splits', for commercial supplies which are derived from different types and contain halves which are variable in shape and size.

If it is desired to produce 'whole' nuts, then the small *Pinang kerdu* type, which resembles the 'Singhala puwak' and bears heavy crops, should be selected and planted in preference to the large forms for the reasons already given.

HARVESTING AND DRYING.

The bunches should be cut only when the fruit is ripe, but it was observed in nearly every place where harvesting operations were in progress that quite a large proportion of unripe, partially ripe, over-ripe and decayed bunches of fruit were collected and mixed with the fully ripe sound ones. This indiscriminate method of harvesting depreciates considerably the value of the produce because the nuts from unripe fruit shrivel up badly in drying and have a dark colour, whilst those from over-ripe ones are most difficult to separate from the husk without damaging them.

A description of the preparation of the nuts for market is given by Stirrup (loc:cit) from whose article the following extract is taken:—

"To prepare the betel nut for market it is necessary thoroughly to dry the fruit. It is very difficult to separate nut from husk when the fruit is newly gathered, but when dry, the husk comes away quite easily. The natives have various names for the finished product according to the method of preparation."

"(a) *Pinang blah*.—To prepare this, an open space is first cleared of all grass, weeds, etc. Then the fruit is split into two halves with a 'parang'* and laid out on this

*A chopping knife.

open space in the sun, split side uppermost. The splitting of the fruit is done by coolies, usually women, who get eight to ten cents per sackful. This wage also includes laying out in the sun, and a cooly who finishes three sacks in a day has worked hard for his 24 to 30 cents."

"If the weather is fine, the outer husk can be separated from the nut quite easily in two to three days, but if the weather is dull or rainy, a day or two longer is necessary. 'Kajangs'† are prepared and kept ready to cover the drying betel nut when it rains. If the nut is soaked with rain during the drying process, the value of the finished product decreases."

"The nut is then separated from the husk and again put out in the sun to dry for three more days. The husk is thrown away or used as fuel by those who make '*Pinang salai*', a smoked preparation of betel nut. When the nuts are thoroughly dry, they are packed up in sacks and sold."

"(b) *Pinang kossi*.—Instead of splitting the fruit, some people put the whole fruits in heaps to dry. These heaps are occasionally turned over to dry the fruit beneath. This method of drying requires very little labour but it takes about three months to dry the fruit sufficiently to enable the husk to be separated from the nut. When the husk has been separated, the nut is again dried in the sun for two or three days before it is ready."

"(c) *Pinang salai*.—This is a smoked preparation of betel nut. A kind of oven is first made of mud, usually about eight feet long by six feet broad and six feet high. The top of the oven is covered only by a bamboo grating and the ripe betel nuts are put on the top of this grating. A fire is then made inside the oven with old betel nut husks. This smoulders and gives off a large quantity of smoke which escapes through the grating and thoroughly smokes the layer of betel nuts above. In about five days the betel nuts are removed and the husk easily separated from the nut. The nut is laid out in the sun for two more days and is then ready for market."

"(d) *Pinang asin*.—Sometimes the fruit is gathered before it is ripe—i.e., whilst still green. This is mixed with salt, put into sacks and kept for two to three months."

The method of drying nuts leaves much to be desired. In very few places are proper drying platforms used or sufficient protection from rain provided, with the result that dirty nuts with poor colour are produced unless the weather is fine during the drying period. An examination of numerous local samples shows that the quality of the nuts could be much improved with more efficient drying.

†Mats made by stitching together the leaves of the screwpine, and used to afford shelter from rain.

COMMERCIAL QUALITIES OF DRIED NUTS.

The commercial value of different kinds of betel-nut for use as a condiment appears to be assessed in other countries, but not to any extent in Malaya, on certain qualities which are difficult to define. For example, merchants in Calcutta state that the Ceylon nut has a white kernel, cuts well and has a superior flavour—qualities not possessed by the Straits nuts. In Ceylon the small variety of nut is said to fetch a higher price and to be preferred for chewing purposes, because it is less strong to the taste than the whiter large variety. Merchants in Singapore, mentioned that nuts from different districts locally possessed distinct characteristics, for example, the Kelantan nuts were hard and sweet; the Muar ones soft, and those from Batu Pahat, hard; but the value of the local product was fixed mainly on its condition in respect of dryness, brightness, freedom from husk and proportion of unripe nuts. The buyers appeared to lay little stress on the size and endosperm characters of the nuts.

The chief centres of origin of the produce purchased locally for export are Johore (Batu Pahat, Muar, Segamat and Kukub), Kelantan, Pahang, Sarawak and the Dutch East Indies.

The chief exporting places are Singapore and Penang whose merchants send the nuts to India (more particularly Calcutta), Burma, Siam, Saigon and Hong Kong. This local export business dates back over 50 years.

The nuts are received in the market in four different forms: (a) whole, (b) split, (c) slices, and (d) smoked.

SAMPLES OBTAINED IN THE SINGAPORE MARKET.

Whole Betel-nuts (Pinang kossi).—‘Whole’ nuts for export are obtained mainly from Sarawak and Dutch East Indies.

Local production is very small, mainly it is believed, (a) because more labour is required to dehusk the nuts than with ‘splits’; (b) because of the long time usually required to dry the nuts in this wet climate; and (c) the difficulty experienced in judging when the nuts are thoroughly dry.

A Palembang (Sumatra) sample examined contained small round and long types which had not been graded. For example, some of the nuts were over 1 inch long and 1 inch wide whilst others were only 7/10 inch long and about as broad. They were fairly well cleaned of husk, but certain of them had been gathered before they were ripe. The ripe nuts had a fairly good colour when cut open, but the endosperm of the unripe ones was of very poor quality. A similar sample of nuts, but of rather better quality, was obtained from Sourabaya (Java).

A mixed ungraded lot from Pontianak (Borneo) contained some imperfectly cleaned and unripe nuts and was of lower quality than those described above.

The sample with the largest whole nuts was one said to have been derived from Pahang. The nuts were mainly of the large round type, about $1\frac{1}{4}$ inches $\times$ $1\frac{1}{4}$ inches. The endosperm was rather dull in colour and many of the nuts were hollow in the centre.

As a rule, small, clean, whole, well-dried nuts realize a higher price than large and medium-sized ones; the reasons given for this are (a) more labour is required to husk small nuts and they are therefore more expensive to prepare; (b) small nuts are of better flavour; (c) they keep better; and (d) the nuts being sold by weight, buyers prefer a larger number of small nuts per given unit than a smaller number of large ones, because if a large one is found to be defective when cut open the loss is proportionately greater than with a small nut. In a sample of large nuts from Pahang, 36 nuts weighed one pound, whereas in a pound of small Ceylon ones there were 90.

The chief way of preparing the nuts for market in India, Burma and Ceylon is in the dried 'whole' form.

Well-prepared 'whole' ripe nuts are certainly far brighter in colour when cut open than those which have been split open prior to drying.

Split Betel-nuts (Pinang belah).—The chief exports of betel-nuts produced locally are in the form of 'splits'. The necessity for devising a means of saving labour and expense and the difficulty of drying the nuts whole in the uncertain seasons experienced here were no doubt responsible for the adoption of this method of preparation, which, by the way, appears to be purely local and not practised to any extent elsewhere. Whole nuts in most seasons fetch somewhat higher prices than 'splits', but the general opinion is that the smaller cost of producing 'splits' more than counterbalances their lower market value. As before stated, large and medium-sized nuts can be more efficiently and profitably handled than small ones, and as the size of the nuts used for 'splits' appears to have little influence on buyers, varieties producing good-sized nuts should be grown.

Kelantan Split.—Mixed types of nut, large, medium and small were found in this sample. The percentage of ripe pieces of good reddish-brown colour on the split surface was 60%; unripe 13%; and over-ripe with portions of husk attached, 27%.

Batu Pahat Split (best quality).—The lot examined consisted mainly of large halves of nuts of the 'telor' and 'jambu' forms with a few of the larger long kinds. The

nuts were nearly all ripe, light-brown in colour on the outside and bright red in colour when cut open below the split surface.

Batu Pahat Split (medium quality).—This sample contained the same types of nut as the above, but had a larger percentage of inferior nuts, besides the colour of the nuts was not good. The proportion of ripe pieces was 61%; unripe 18%; and over-ripe 21%.

Muar Split.—The sample consisted of mixed types of nut, large, medium and small. It contained 62% of ripe, 21% unripe, and 17% over-ripe pieces. The colour of the nuts was dull and they closely resembled the 'Batu Pahat medium quality.

The above results of the examination of local commercial samples of split betel-nuts clearly show that there is much room for improvement in the methods of harvesting and drying the nuts.

Smoked Whole (Pinang salai).—The samples examined from Johore, where this class of produce is prepared on a small scale, consisted mainly of large round whole nuts of a dark reddish-brown colour throughout. In this form the nuts are said not to be attacked by insect pests when stored, as are nuts which are sun-dried only.

The production of smoked nuts is small and the exports go mostly to Bombay.

Sliced.—There is a small output of sliced betel-nuts mainly from the Kukub District of Johore. This product consists of thin dark reddish-brown cross sections of unripe nuts. In preparing these, the nuts are first sliced, then boiled and dried, or merely sliced and dried only. The trade in these sliced nuts is chiefly with the Coramandel Coast of India.

DRIED SAMPLES FROM CEYLON.

Three commercial samples of betel-nut were obtained through the Ceylon Chamber of Commerce; these were classed as:

- (1) Small, whole, valued @ Rs. 26/- per cwt. (Dec. 1925).
- (2) Medium, whole, valued @ Rs. 25/50 per cwt. (Dec. 1925).
- (3) Large, whole, valued @ Rs. 25/- per cwt. (Dec. 1925).

These were graded samples of well-prepared ripe nuts of good quality.

Small Whole.—The sample consisted of ripe, clean, light-brown nuts. Somewhat variable in shape, but mostly of small, long, conical type, about $9/10$ inch $\times$ $8/10$ inch. When cut open the nuts were hard, solid, bright red in colour with a small proportion of white endosperm.

Medium Whole.—This was a larger grade of the same type of nuts as the above, averaging about 1 inch $\times$ $9/10$ inch broad.

Large Whole.—This sample contained nuts variable in size and shape, but the majority were of the large long type. In size they averaged slightly over 1 inch long and nearly as broad. The character of the endosperm was similar to that of the small and medium nuts.

DRIED SAMPLES FROM CALCUTTA.

A collection of seven commercial qualities of dried nuts was received from the India Museum (Industrial Section), Calcutta in January 1926. It consisted of—

- (1) Supari (big) from Bombay, valued @ Rs. 25/26 per maund.
- (2) Areca Nuts from Rangoon, valued @ Rs. 24/25 per maund.
- (3) Supari (Dofali) boiled, origin unknown, valued @ Rs. 27/28 per maund.
- (4) Supari (Desi) from East Bengal, valued @ Rs. 35/56 per maund.
- (5) Supari (Desi) from Bengal, valued @ Rs. 34/35 per maund.
- (6) Narkeli Supari from South India, valued @ Rs. 26/27 per maund.
- (7) Supari (Desi) with shell, from Suburbs of Calcutta, valued @ Rs. 20 per maund.

(1) *Supari (big) from Bombay.*—The sample contained large, clean, ripe nuts mostly of a flattened round type, broader than long, about $9/10$ inch long and $1\frac{1}{4}$ inches wide; but there were also specimens of large long nuts mixed with them. The size, shape and the endosperm characters of nuts resembled the local 'telor' and 'jambu' forms.

(2) *Areca Nuts from Rangoon.*—This was a poor sample of large and medium-sized round nuts containing a large percentage of unripe and discoloured nuts.

(3) *Supari (Dofali) boiled, Origin unknown.*—This was a rather poor sample of the Malayan 'splits'. A number of

unripe discoloured nuts in the sample may have conveyed the impression that the nuts had been boiled.

(4) *Supari (Desi) from East Bengal*.—This, the highest priced sample, consisted of medium to small ripe, clean round, flattened nuts, broader than long, averaging about $8/10$ inch $\times$ 1 inch. The endosperm was of good colour, a fairly large amount being white.

(5) *Supari (Desi) from Bengal (proper)*.—This sample was placed second in order of value. It contained very small clean, ripe, round, flattened and also ovoid-conical nuts. The round flattened ones were $6/10$ inch $\times$ $7/10$ inch and smaller, the conical ones about $7/10$ inch $\times$ $6/10$ inch.

When cut open, the nuts were solid and appeared to contain a rather higher quantity of white endosperm in the centre than the small samples examined from other places.

(6) *Narkeli Supari from South India*.—This sample contained mostly long, conical nuts of medium and small size. The endosperm was bright in colour, the proportion of white being rather higher than in the small Ceylon and local 'kerdu' types which the nuts resembled.

(7) *Supari (Desi) with shell, from Suburbs of Calcutta*.—The sample contained dried 'whole' fruits of a small variety of *Areca Catechu*. The fruit was similar in size to the local 'kerdu' type, but rather more globose in shape. The pericarp was thin so that the nut could be readily extracted. The nut was small to medium in size, round, flattened, as broad or broader than long.

The dry pericarp of the fruit no doubt protects the enclosed nut from insect attack and may be the reason why the produce is prepared for market in this form.

It was observed that the Ceylon and Indian samples described above were mostly graded and sorted and contained well-dried ripe nuts with endosperm of good bright colour, therefore should it be desired to produce 'white' nuts locally for the export trade, the grading and sorting of the nuts would have to receive attention.

It has been mentioned that certain characters from a masticatory standpoint which are difficult to describe, occur in nuts from different districts of Malaya and elsewhere. It is likely that these would continue to exist even in a pure cultivation of a particular variety grown under dissimilar physical conditions, such as length of wet and dry seasons, rainfall, humidity, soil, temperature and light—all of which influence the physiological functions of a plant. The peculiar qualities referred to are not, however, of prime importance.

REFERENCES.

- (1) Stirrup, H. H. ... The Betel Nut Industry in the Muar District, Johore. The Agricultural Bulletin of the Federated Malay States, Vol. V., Nos. 5—6, (February—March, 1917).
- (2) Flippance, F. ... Betel. Gardens Bulletin, Straits Settlements, Vol. II, No. 8, (June, 1920).
- (3) Beccari, O. ... The Palms of the Philippine Islands. The Philippine Journal of Science, Vol. XIV, No. 3, pp. 300—313, (March, 1919).
- (4) Ridley, H. N. ... Flora of the Malay Peninsula. Vol. V, Page 4, (1925).
- (5) Watt, Sir G. ... The Commercial Products of India. London, 1908.

Received for publication 15th June, 1926.

THE BETEL-NUT INDUSTRY.

D. H. GRIST.

ATTENTION has been directed to the betel, areca or pinang nut industry owing to the steadily improving price which it has commanded during the last ten years. The present enquiry has therefore been directed to investigate the sources of supply, the varieties cultivated, and the grades and prices of the marketed product—with a view, if possible, of directing attention to the possibilities of developing the cultivation of the crop as a plantation industry, and of placing on the market the highest grade of product that is economically possible.

As far as the writer is aware, there are at present no large single plantations of betel nuts in bearing in Malaya. Such plantations as do exist, although in the aggregate very large in extent, are owned by Malays or Chinese, who hitherto have paid but scant attention to the question of cultivation, or to the selection of varieties. By far the largest area exists in Johore, principally centered in the districts of Batu Pahat and Muar. In either centre, especially in the former, one may walk for considerable distances through groves of apparently deserted palms of all ages, definitely and regularly planted, but containing a heavy undergrowth ofalang, blukar or ferns: conditions which, it is obvious, must seriously affect the growth and yield of the palms. Enquiry amongst the owners and buyers of betel-nuts in these districts evinces the fact that no great care is taken in the selection of varieties or in curing the product: that no labour saving methods have been adopted which might tend either to improve the quality of the nuts as exported, or to lower the cost of production. This being the case, it is not surprising to find that the crops obtained are very small and difficult to estimate and that the betel-nuts exported command a lower price than do the nuts from Ceylon where more care is taken in preparation and in grading.

CULTIVATION.

The betel-nut palms of Johore make remarkably good growth—in spite of neglect. They flourish best on the rather peaty lands of Batu Pahat. Good palms are also found in various districts, growing on alluvial land by rivers or on a fairly rich loam. From various authorities, it is evidently the opinion that they favour land containing plenty of humus, which gives rise to Stirrup's (1) observation that in the Muar District of Johore, only virgin jungle land is planted with betel-nuts. Choice of land should therefore conform to the above general conditions in a district with a well

(1) The Betel-nut Industry in the Muar District Johore—Bulletin Federated Malay States, Vol. V, Nos. 5—6, (1917).

distributed rainfall. Manuring is said to have a considerable effect on the yield of nuts.

The seeds are planted in a nursery from which they can be transplanted after a lapse of six to eighteen months.

The most suitable planting distance is 8 feet x 8 feet, which gives a stand of 680 trees per acre. The palms come into bearing in about seven years, and continue to yield remunerative crops until they attain an age of about forty years. When the palms are about twenty years old, inter-planting is effected, so that as the older palms go out of bearing they are replaced by the next generation of palms.

The bunches of fruit, when ripe, are removed by means of a long pole to the end of which is attached a sickle. The subsequent treatment of the fruit depends upon the description of finished product it is desired to obtain.

COUNTRIES OF PRODUCTION.

The betel nut has been a source of trade in India, Ceylon, Netherland East Indies and Malaya from time immemorial. "It was always the chief source of Ceylon trade in the anti-British times. In the Portuguese era, great quantities of the nuts were exported, and we suspect that these formed the chief medium of exchange for the grain which the natives of Ceylon have for centuries drawn from Southern India."*

The betel-nut palm also flourishes on the Malabar Coast, Cochin China, Siam, North of Bengal and in Zanzibar.

India with its enormous population, 80% of whom are estimated to be consumers of betel-nuts, is unable to satisfy her internal demand, and, as will hereafter be seen, practically the entire export of the other large betel-nut producing countries is absorbed by India.

Malaya.—Outside Johore, there are very few definitely planted areas under this crop. It is usually planted in native holdings, mixed with fruit and other trees, with the sole idea of satisfying the personal requirements of the owner, but without the intention of exporting any surplus. In Johore, however, it is estimated that there is an area of 7,500 acres planted with the palm. The main sources of export in Johore are from the district of Batu Pahat, Muar and Kukub; whose exports in 1924 were respectively 6,000; 1,800 and 3,000 tons; being about 3,000 tons less than the preceeding year, in spite of improved prices.

The Malayan trade in betel-nuts is however, a very important one, as will be seen by the following tables of trade, which have been compiled from the official figures of the Trades and Customs Department.

* "All about the Areca Palm" by J. Ferguson, Ceylon 1897.

TABLE 1.

British Malaya Trade in Betel-nuts.

IMPORTS.

Year.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925.
Total in tons	51,251	51,177	46,855	42,863	48,275	58,822	56,626	39,952
—of which from N. E. I	—	33,151	27,031	27,750	30,056	39,144	36,815	—
Unfederated Malay States	—	16,509	19,059	13,953	16,256	17,136	15,492	—
Total value of imports £	720,343	781,393	979,677	645,132	780,725	1,125,536	1,235,653	1,177,396

EXPORTS.

Total in tons.	53,410	56,371	48,158	49,341	51,429	63,729	62,166	58,902
—of which to British India and Burma	—	49,908	37,485	38,232	40,525	51,993	51,499	—
Total value of Exports £	904,105	1,005,610	1,253,874	869,366	977,466	1,467,112	1,757,845	2,153,125

Netherlands East Indies.—In comparing this table with table 2,—which was obtained from an official Dutch source—an obvious discrepancy is seen, which is probably due to the difficulty in compiling accurate records from all the Dutch Islands in the Outer Provinces. It is undisputed however, that practically the entire exports from the Netherland East Indies find their way to the Singapore market for re-export to India.

THE NETHERLANDS EAST INDIES TRADE.

TABLE 2.

Export of Betel-nuts from the N.E.I. in tons.

Year.	Java and Madura	Outer Provinces	Total.
1921	6,687	20,175	26,862
1922	7,388	21,979	29,367
1923	7,707	28,495	36,302
1924	6,803	29,170	35,973
1925*	5,687	30,862	36,549

Ceylon.—The export of betel-nuts from Ceylon has greatly increased in recent years. The maximum exportable quantity would appear to be about 8,500 tons; the average annual export between 1850—1896 being about 5,000 tons per annum; while in the last ten years the average export has been 7,500 tons per annum. The Official Hand Book of Ceylon for 1925 makes the following comments on the industry in that country.

“Conditions.—The Arecanut palm is grown in all village gardens in the wetter districts of the Colony. It is the commonest feature of village vegetation, and produces heavy crops of fruits, as well as providing straight stems, which are used for the erection of temporary structures. Pure cultivation of the palm similar to those to be found in Southern India are rarely seen in Ceylon, although in the Kegalle District there are some fairly extensive pure plantations. The area under arecanuts is about 63,000 acres. There are several varieties of arecanuts grown, and the respective values of these are well known to the purchasers of fruits. Little care is, however, taken in the selection of fruits for planting, and no attempts have been made to improve the local types. Planting of arecanuts still con-

* Provisional figures.

tinues in village holdings, but in many instances this palm is being replaced by the coconut, which at present is more profitable."

"The Fruit.—The fruits of the Arecanut palm are harvested when ripe, and are sold in their unhusked state in all the bazaars and markets of the Island. The dried product is also readily procurable in the majority of boutiques. It is cut into thin shavings, which are used for 'chewing' with the betel leaf, lime, and occasionally, tobacco, by the greater portion of the village population of the Colony. The price of unhusked arecanuts is about 30 cents per 100, of husked nuts 35 cents per 100."

"Quantity and value of Exports.—The quantity and value of the exports of the Arecanuts from Ceylon are shown in the following tables:—

QUANTITY AND VALUE OF THE EXPORTS OF BETEL-NUTS.

(Ceylon produce).

TABLE 3. †

Year.	Tons.	Value Rs.
1909	7,482	2,378,476
1910	6,895	2,697,550
1911	5,825	2,423,015
1912	5,795	2,824,960
1913	5,102	3,039,133
1914	4,660	1,798,439
1915	8,592	3,345,711
1916	6,160	2,801,520
1917	7,700	2,923,822
1918	10,739	3,801,682
1919	7,522	3,059,158
1920	6,202	2,923,822
1921	6,552	3,308,073
1922	6,676	3,331,148
1923	8,029	3,554,212
1924	6,545	3,294,961

"Arecanuts are generally exported to India and the Maldivé Islands, about 96% going to the former and about 3.5% to the latter."

"Some enquiries have recently been made as to the prospects of plantations of this palm. It grows readily in

† Hundred-weights have been converted into tons for the sake of comparison with other tables. Owing to the fluctuations in the value of the Rupee, the values have not been converted.

the damper districts below 2,500 feet elevation, and is free from serious pests and diseases. In South India the coconut is in many places replacing it, and it is possible that with this diminution of cultivated areas in India, the future prospects of arecanut cultivation are worthy of investigation."

India.—The following statistics drawn from official records shew the essential figures of the consumption of betel-nuts in India:—

TABLE 4.

Import of Betel-Nuts into British India.

Country.	Quantity (Tons.)			
	1919-20	19 20-21	1921-22	1922-23
Ceylon	6,367	5,749	6,387	6,768
Straits Settlements	49,819	40,173	42,658	48,497
Other Countries	121	1,862	139	190
Total	56,307	47,784	49,184	55,455

The exports of betel-nuts from India are negligible.

PRICES.

The Statistical Office, Singapore in "Average Prices and Declared Trade Value 1925" state the following average declared value of exported betel-nuts per picul (133 lbs.) over the period 1890 — 1925.

1890 — 1919	- \$5.40	1913	- \$ 6.76
1890 — 1899	- 4.07	1920	- 13.17
1900 — 1909	- 5.47	1921	- 9.21
1910 — 1919	- 6.72	1922	- 9.66
		1923	- 11.82
		1924	- 14.69
		1925	- 18.54

The following percentge relatives of average declared values 1900—1925 (base year 1913), drawn from the same source shew the sensational rise in value during this period; a rise which has only been exceeded locally by gambier and nutmegs, both of which are relatively of inferior importance to the trade in betel-nuts. Similar figures for rubber — a commodity which is well recognised as exhibiting sensational fluctuations, is given for comparison.

TABLE 5.

	1900-9	1910-19	1913	1920	1921	1922	1923	1924	1925
Betel nuts	80.9	99.4	100	194.8	136.2	142.9	174.8	217.3	274.8
Rubber	204.7	121.6	100	73.2	26.4	27.7	47.4	43.0	96.4

PROSPECTS AS A PLANTATION INDUSTRY.

It remains, therefore, to decide the probable future supply and demand for betel-nuts; the prices of different grades of the product, compared with their respective costs of production, and lastly the possibility of making a profitable investment of a betel-nut cultivation on a plantation scale.

There appears to be a widespread belief that the quantity of exportable betel-nuts is decreasing, and that this fact is accountable for the increase in price. This is not borne out by the figures given in preceeding tables. It is evident that the production of betel-nuts has decreased in British Malaya, but on the other hand it has increased in the Netherland East Indies and Ceylon. It is more probable that while the aggregate quantity available has remained fairly steady, the demand in India has increased. This may be due, as is suggested by the Ceylon authority already cited, to the replacing of betel-nuts plantations by coconut plantations in India; or it may be due to an improvement of conditions in India which would encourage the luxury of betel chewing.

A large firm of exporters in Singapore state as their opinion that India can consume greatly increased supplies in spite of high prices. It must be assumed that the demand for betel-nuts will be maintained. It is not probable that the supply from Ceylon will materially increase, the greatest competitor therefore being the Netherlands East Indies, herself a large consumer.

As will be seen from the preceding account of the method of cultivation of this crop, the cost of bringing into bearing under the native system — or lack of system — is very small, and probably does not exceed \$200/- per acre. Were the cultivation conducted as a plantation industry, with efficient supervision and the planting of cover crops. construction of drainage, etc, the cost would be approximately that of a coconut estate — say \$350/- per acre.

The average crop, per acre, in Johore is said to be about five piculs per acre per annum (about 6 cwts).^{*} This is very much lower than other writers have stated. Stirrup gives 50 piculs (which, being computed from the average number of nuts per bunch, and the number of nuts per palm, is too high.) A Ceylon estimate, gives the average yield per palm, when planted 1,200 per acre at 100 nuts, but when planted 750 trees per acre, at double this amount — about 120,000 nuts per acre, while 12,000 nuts are required to prepare one cwt. of the dried product. But in the absence of more reliable evidence it must be assumed that the Johore figures roughly represent the yield in this country, remembering at the same time that there would be a considerable increase in yield if proper attention was paid to cultivation.

If the estimate of crop obtained under native conditions be accepted, then, for the purposes of arriving at probable profits, the probable cost of production under the same conditions must be admitted. These costs include cost of rent on land, felling, clearing and planting, and interest on capital for seven years. A generous figure would be \$200/- per acre.

Manufacture.—

5 piculs of dried betel-nuts per acre @ \$13.00 per picul.

Cost of harvesting		1.00
Cost of cutting and extracting nuts @ 12 cents per 1,000		1.44
Drying	 Say	1.44
Bags		1.00
Total		\$ 4.88
Say		\$ 5.00
Profit per picul \$8/-		
or \$40/- per acre.		
= 20%		

The above figures are certainly very conservative, because, if the same figures be applied to cases where the Chinese dealer purchases the total standing crop throughout the year and add his cost of harvesting — it will be seen to leave no margin of profit; and those acquainted with the shrewd business abilities of the Chinese shopkeepers can hardly credit such philanthropy.

Hire of land.....\$40/- per acre.

Cost of harvesting and preparation

per picul @ \$5/-

35/- „

Crop of 5 piculs

\$75/- „

Value of five piculs of dried nuts, about \$75/- per acre.

^{*} Judging by the fact that the standing crop is frequently sold for \$40—\$50 per acre, per annum, I am inclined to think that the yields are greater than this.

It is evident therefore that the above cost of production, and the estimated crop, per acre, do not err in taking too optimistic a view of the profits to be derived from the cultivation of betel-nuts.

In Ceylon, where betel-nuts have received cultivation, crops up to 30 cwt per acre are stated as being the average. Presuming, therefore, that cultivation similar to that of rubber be given, the capital cost would be in the neighbourhood of \$400/- per acre for which a 25 picul crop would give a profit of 50%. It may be thought that this estimate of crop is too high, but it would mean but two bunches of 200 fruits per annum, per tree which, with cultivation, is not a high standard of cropping.

CONCLUSION.

The betel-nut industry in Malaya is capable of considerable extension. As has already been pointed out, the selection of seed, and improved methods of cultivation would result in a greatly increased crop.

In addition to such changes as have been indicated above, more careful preparation of the product for the market would still further enhance the market price. The betel-nuts exported from Ceylon command a much higher price than those from Singapore, due partly to the fact that the nuts are generally of a smaller variety — and for that reason more highly esteemed by the consumer.—and in part because particular grades are prepared for certain markets. These more expensive grades call for greater labour in production, but it would seem that in Ceylon the higher price more than compensates for the outlay. On reference to the preceeding article it will be seen that the local product contains a considerable proportion of unripe nuts, over ripe nuts, and of nuts which have become damaged by rain. Greater care in grading would eliminate the inferior nuts from the higher grade.

At present, each nut is handled separately not less than four times — i.e. in splitting, in spreading the split nut to dry, and in removing the nut from the husk. Grading for ripeness or size is possible during any of these operations. The larger portion of nuts damaged by becoming wet and muddy might be eliminated if a simple form of dryer be employed; this too, would reduce the cost of drying on account of the cost of handling. The system at present of exposing to the sun each split nut with the cut surface uppermost, an operation which must be repeated after every rain, and in any case each morning for four days, is an unnecessary waste of labour.

The operation of removing by hand each half nut from the husk might be abolished, and replaced by a mechanical de-pericarper. The writer is not aware of a mechanical de-

pericarper ever having been tried for betel-nuts, but considering that such widely differing seeds as oil palms and coffee are treated in this manner, there would appear to be no reason why one of such machines should not be adapted to betel-nuts.

ACKNOWLEDGMENTS.

The writers are indebted to Mr. F. de la Mare Norris, Inspector of Agriculture, Johore for his valuable assistance in the betel-nut investigations made in the State of Johore; and also to Messrs. The Lianqui Trading Company, Singapore for the most useful information they supplied concerning the local and export trade in betel-nuts.

SUMMARY OF PRECEDING PAPERS.

- I. A description is given of the vegetative, flowering and fruiting characters of the betel-nut palm (*Areca Catechu*, L.) and the uses to which its seed (nut) is put.
- II. Observations on the male and female flowering phases of the palm indicate that, under local conditions, the female flowers are normally cross-pollinated, but that occasionally self-pollination is possible in young palms when growing rapidly.
- III. Numerous types of the palm occur locally, many of which may be unstable hybrids. The named types which frequently occur in plantations are described, and the opinion is expressed that certain of these if selected and isolated would produce nuts equal in quality and value to those of India and Ceylon.
- IV. It is pointed out that genetical investigations extending over several years would be necessary before definite information concerning the hereditary characters of the different varieties and types could be obtained.
- V. Advice is given respecting the selection of fruits for planting purposes.
- VI. A description of the local methods of harvesting and drying the fruits and nuts is given. It is shown that at the present time these methods are defective, and suggestions for their improvement are made.
- VII. The results of an examination of commercial samples of nuts from India and Ceylon as well as from various local sources are given.
- VIII. A review of the present state of the trade in betel-nuts and the betel-nut industry is given, and conclusions are drawn respecting the possibilities of extending the cultivation under plantation conditions.

Received for publication 15.6.26.

PLATES TO ILLUSTRATE PAPERS ON BETEL NUTS.

Plate I.—A young betel-nut palm plantation at the Government Experimental Plantation, Serdang. The palms were planted on January 27th 1923, and certain of them commenced to flower in August 1925.

Plate II.—An old plantation in the Batu Pahat District of Johore. The palms are about 30 years old. Split fruits, being sun-dried, are seen in the foreground.

Plate III.—Branches of inflorescence of *Areca Catechu* L. At left, a branch nearing the end of the male flowering phase. A few of the small white male flowers can be seen on the branchlets with larger unopened female flowers at the base. At right, a branch in the female flowering phase. The female flowers are in the receptive stage. No male flowers are present.

Plate IV.—Sketches of fruit of certain local types of *Areca Catechu* L., and that of *Actinorhytis Calapparia*. Wendle and Drude.,

- | | | |
|-----|-------------------|---|
| 1. | Pinang Wangi Sali | (<i>Areca Catechu</i> L.). |
| 2. | „ Wangi | - „ |
| 3. | „ Telor | - „ |
| 4. | „ Jambu | - „ |
| 5. | „ Sembawa | - (<i>Actinorhytis Calapparia</i>
Wend: and Drake). |
| 6. | „ Seluang | - (<i>Areca Catechu</i> L.). |
| 7. | „ Ranggong | - „ |
| 8. | „ Gading | - „ |
| 9. | „ Malan | - „ |
| 10. | „ Betul | - „ |
| 11. | „ Bonto Tabon | - „ |
| 12. | „ Kerdu | - „ |

Plate V.—Heaps of freshly collected betel-nut fruits in the Muar District of Johore.

Plate VI.—Types of betel-nut in a commercial sample of Batu Pahat split nuts. The wide variation in the size, shape and character of the nuts is clearly shown.

Plate VII.—Graded whole nuts from Ceylon:

- A.—Large.
B.—Medium.
C.—Small.

Plate-VIII.--Varieties from Southern India:

A.—Fruit and nut of Round Large Variety.

B.— ,, ,, Round Small ,,

C.— ,, ,, Convex-shaped ,,

D.— ,, ,, Pointed top ,,

E.— ,, ,, Long ,,

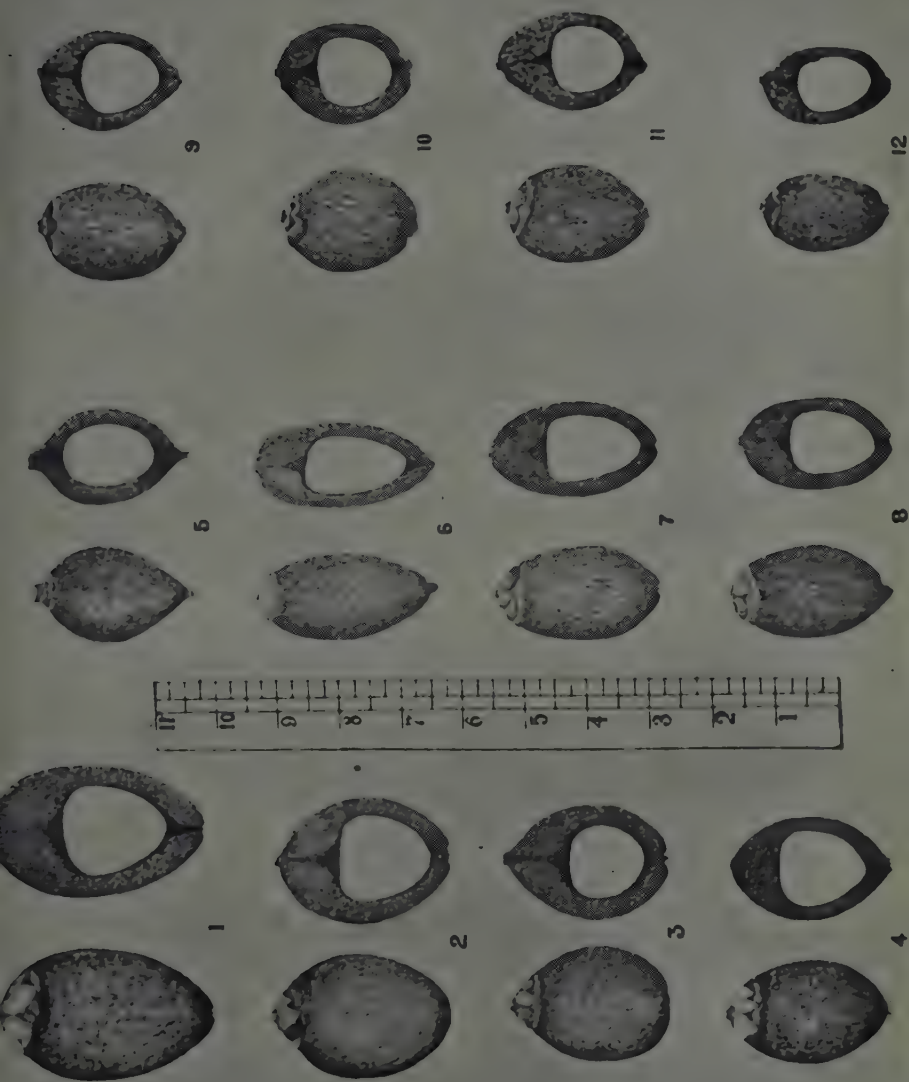
F.— ,, ,, Narrow based ,,

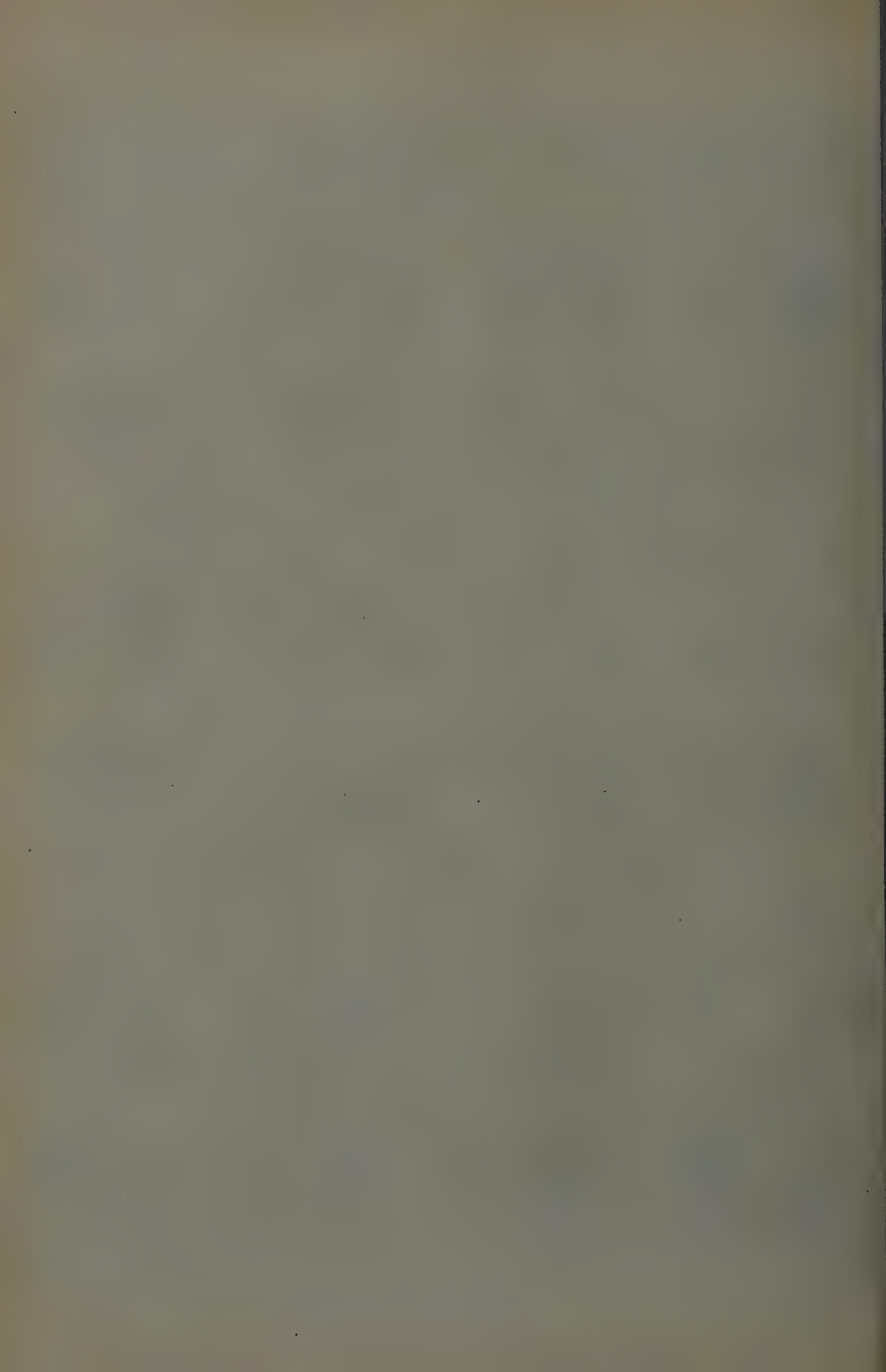




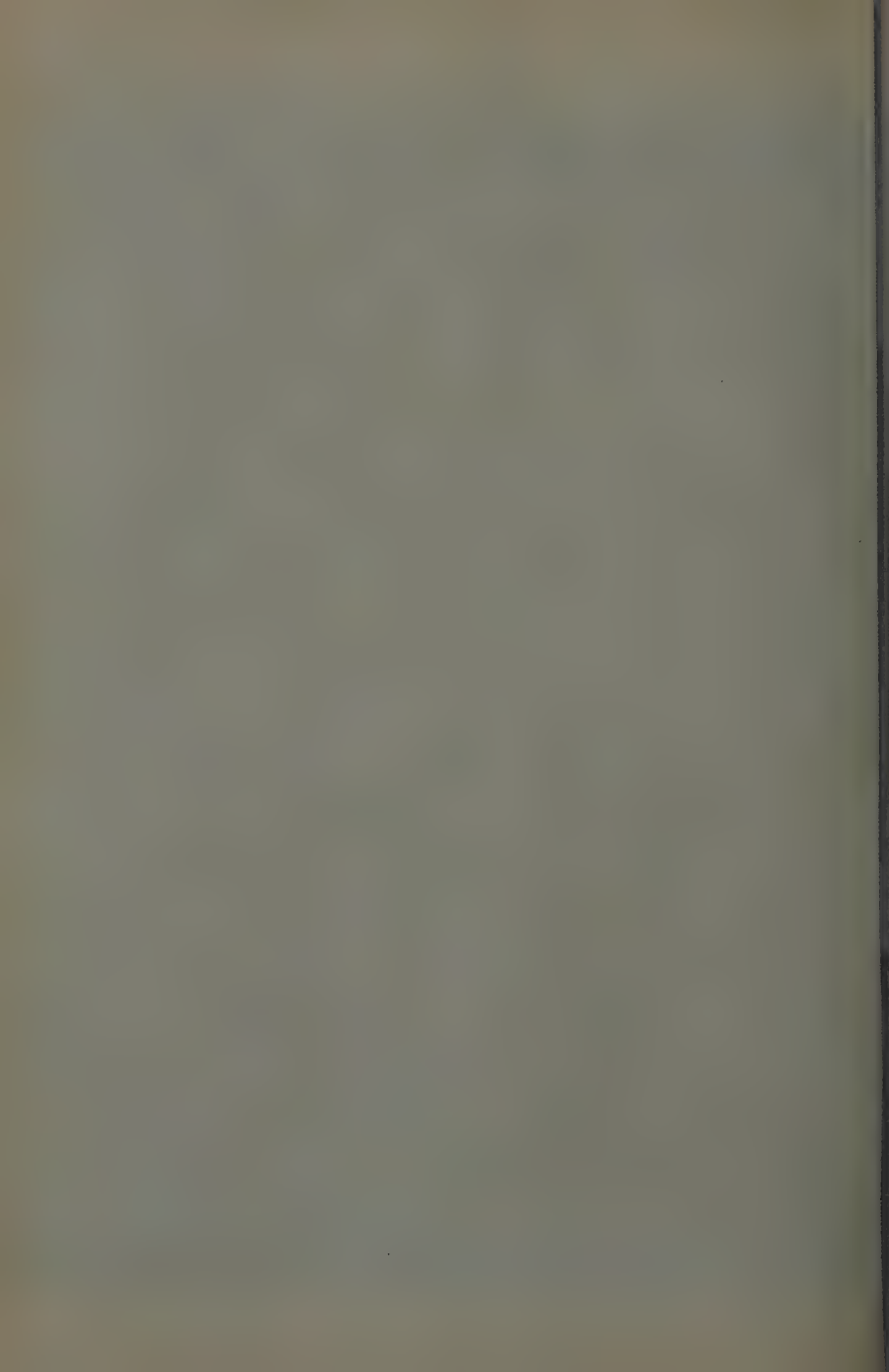


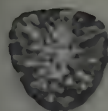
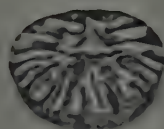
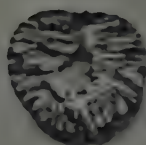
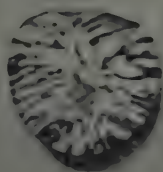


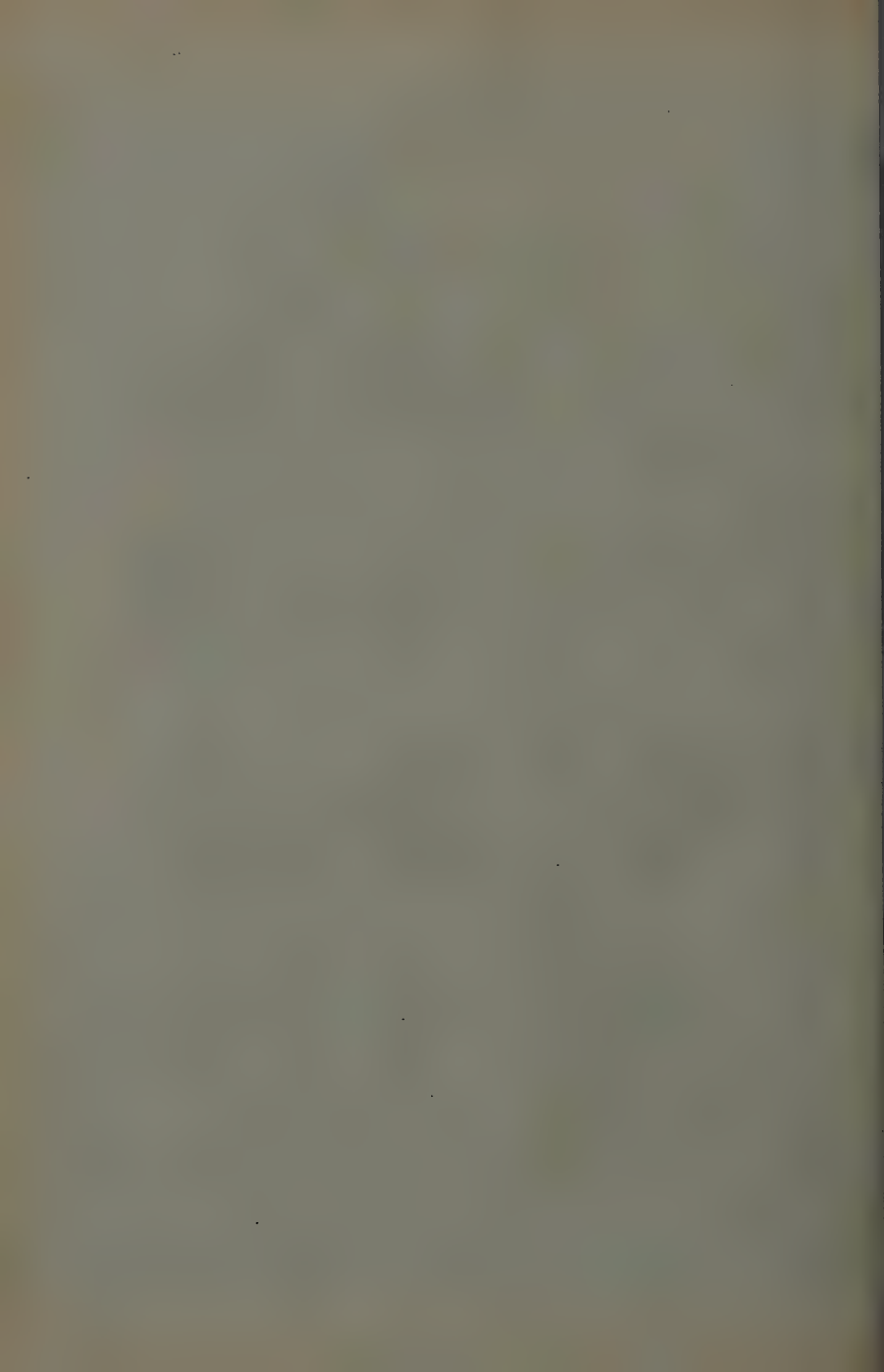


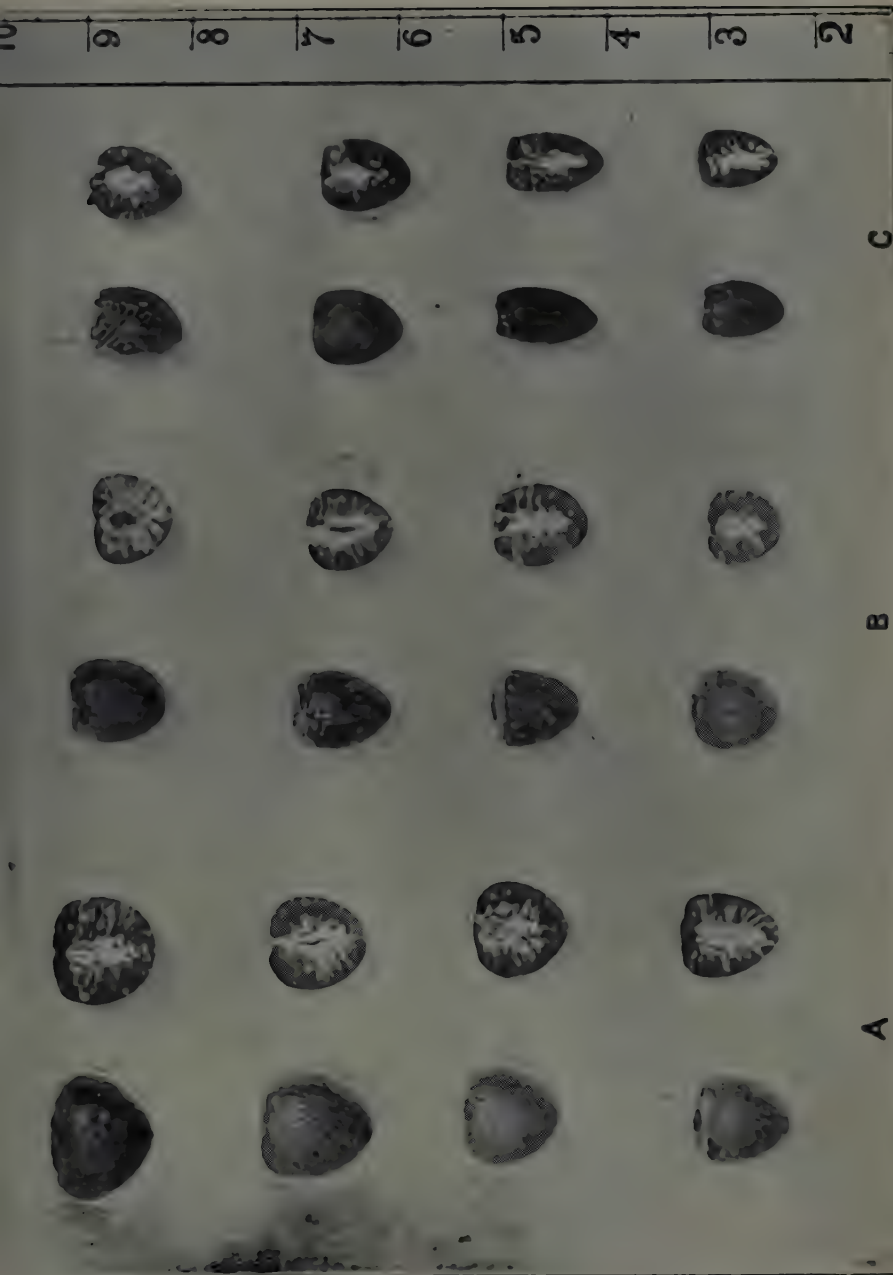


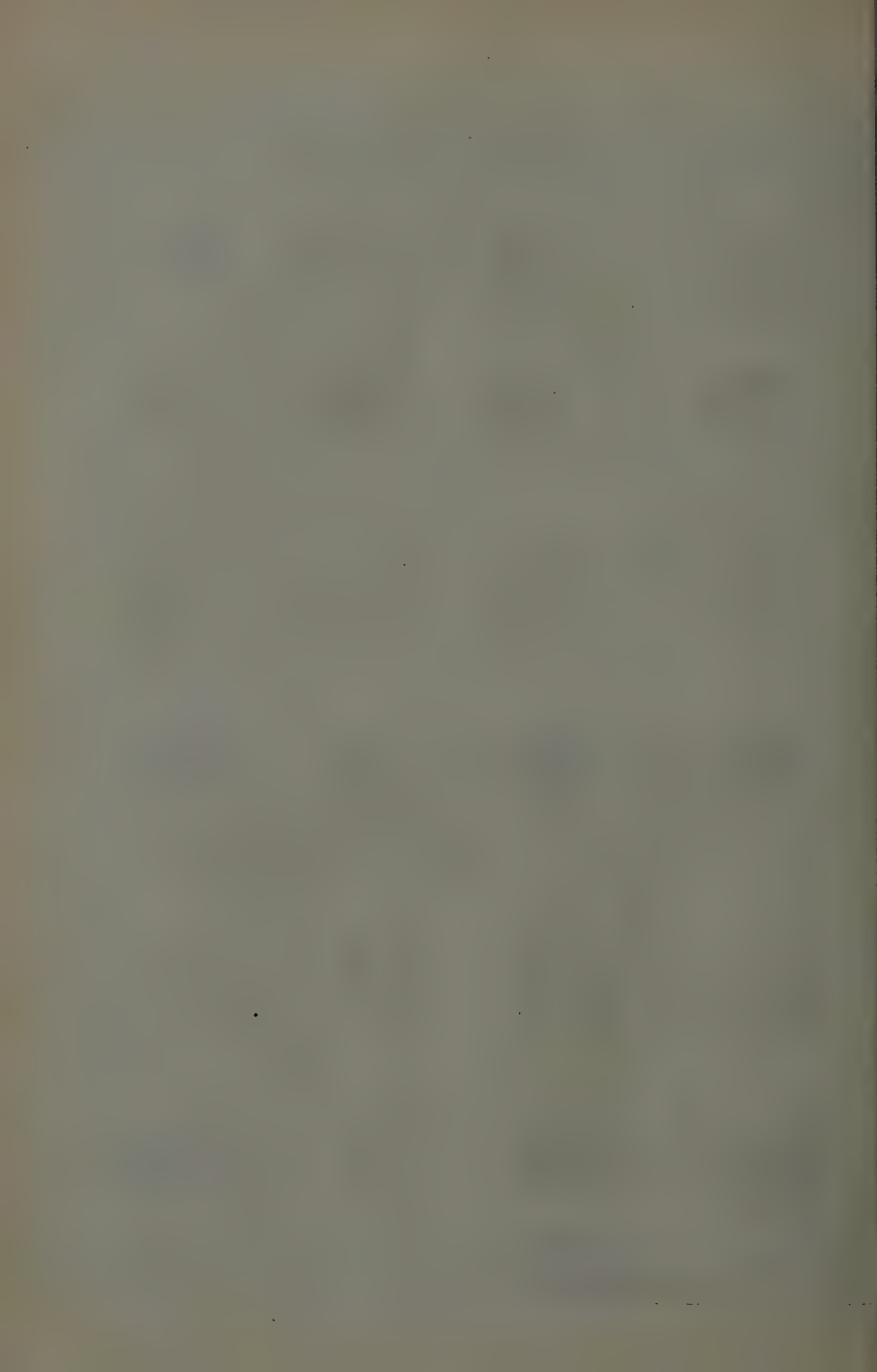


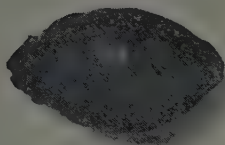
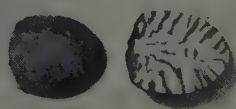
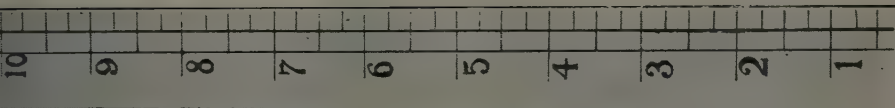




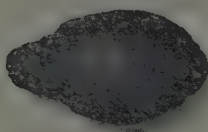




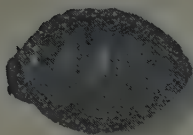
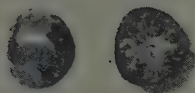




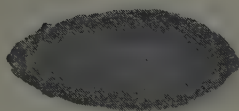
C



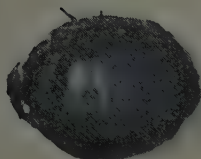
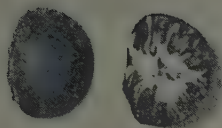
F



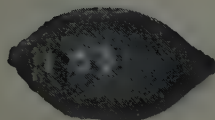
B



E



A



D

THE GIANT SNAIL (*ACHATINA FULICA*, FER.) IN MALAYA.

F. W. SOUTH.

THE African, or Giant, Snail is a native of West, South and East Africa, but during the last 70 years it has been conveyed to Mauritius and the Seychelles, India, Ceylon and Malaya. The history of its introduction into Mauritius is not known, but Green (1) states that by 1910 it had been present there for many years and was then said to have become a common object in that island. Godwin-Austen (2) gives the history of its introduction into India where he observed it in the neighbourhood of Calcutta in 1876—77. He states that it was introduced some 20 years previously, i.e. about 1857, by Mr. Benson after his arrival from the Cape and Mauritius. Annandale (3) states that the specimens were introduced for purposes of dissection and that they came from Mauritius. Green (Ibid p. 62) was informed by Dr. Annandale that the species was common in 1910 in Calcutta and apparently all over Northern Bengal.

Green (Ibid p. 60) also gives the history of the introduction of the snail into Ceylon. About the year 1900 an enthusiastic collector received living specimens of the snail from abroad and liberated them in his garden near Watawala. Although, acting on Mr. Green's advice, he subsequently destroyed them and appeared to have successfully exterminated the whole brood, two of the snails were conveyed by a dhobi from Watawala to Kalutara in some cabbages and were thrown out into the garden. These seem subsequently to have given rise to the vast swarms of snails that appeared at Kalutara some 10 years later in 1910. The snails subsequently spread widely, as is shown by Hutson's (4) account of their distribution in Ceylon in 1920.

HISTORY IN MALAYA.

The exact date when the presence of these snails in Malaya first received attention is uncertain, but the available evidence indicates that they have been present in Kedah and Singapore for about 15 years. Cribb (5) states that some years ago he received a tin containing specimens of *Achatina* from Kedah, but he does not give the actual date. Jarrett (6) examined and identified specimens sent to the Singapore Museum in February 1922 by Mr. Lim Khye Liang. These were found in a compound in the Balestier district of Singapore. In the same month Mr. Jarrett received other specimens from Mr. W. H. R. Allen of the Straits Trading Company, then resident at Butterworth. These specimens came from the gardens of "Castledale" and an adjoining house on the beach at Butterworth, where the snails had been present since September 1921.

At the end of March 1922 the Senior District Officer, Province Wellesley, informed the Agricultural Field Officer, Penang and Province Wellesley, of the presence of the Giant Snail in these gardens at Butterworth and this was the first occasion on which its existence in the Peninsula became known to the Department of Agriculture. This report led to correspondence with the Director of Raffles Museum who kindly supplied further information about the snail and reported its presence in Singapore. Later enquiries by the Agricultural Field Officer, Penang and Province Wellesley, revealed that the snail had been present for some years in the garden of a bungalow on an Estate in the North East of Province Wellesley on the Kedah border. The acting Manager of this Estate had, more than ten years previously, seen these snails brought in large baskets from Kedah into the Province by the Chinese in his district, who cooked them and used them as duck feed. They were, therefore, present in Kedah as early as 1911. It is believed that they were conveyed to Butterworth, probably as eggs, with plants from the Estate garden given to the occupants of "Castledale" (8).

Reports on these snails at Butterworth have appeared in the *Malayan Agricultural Journal* each year for the last four years (See References). These show that the snails were kept in check by hand collection, though they spread to some extent to the east of the coast road running north from Butterworth, and appeared in the compounds of houses around the District Hospital where the land is low-lying and damp. The sandy conditions in the beach gardens were not very suitable to them. Heavy floods in August 1924 killed off many of the snails around Butterworth and drove others to climb undergrowth and fences, or anything else above water, so that they were easily collected and destroyed. Since then only a few have been seen at Butterworth.

In August 1925 specimens were seen in the grounds of King Edward VIIth School at Taiping, while an Agricultural Show was in progress. Their presence on the Show ground suggested the possibility that the individuals seen might have been brought with exhibits from Kedah or the Province. However, when they were pointed out to the Agricultural Field Officer, Perak North, Mr. F. Birkinshaw, he stated that the snails occurred in other gardens in the town, and that he remembered noticing them when he first went to Taiping in 1920. Though he had known them for the last five years, they had never been present in large numbers or done much damage. During the present year, however, they have become more numerous in Taiping. In June the Agricultural Field Officer, Perak North, reported that large quantities of snails were collected each morning in the Hospital compound and that quantities had been collected a short while previously in the Church compound. This month (July) a report has been received that the snails are to be found in the garden of "the Cottage" on Maxwell's

Hill and in the jungle nearby. This report is being investigated. There seems to be little doubt that it is correct; if so, the presence of the Giant Snail at an elevation of 4,513 feet is note-worthy. Hutson (4) remarks that, although *Achatina* is known to occur at elevations above 3,000 feet in Ceylon, it does not seem probable that it will increase to any great extent at such elevations.

In Singapore the snail seems to have increased in numbers steadily from March 1922 onwards and to have multiplied fairly rapidly in the last nine months. Recent investigations show that the snails are very numerous in hedges along Thompson Road, where the children of the Thompson Road school have collected them in large numbers, and in hedges or other damp, sheltered places along Moulmein Road, Rangoon Road, Kampong Java Road and Race Course Road, in fact in the whole area round the Race Course. From there they extend along Balestier Road and Target Road and are very numerous on land along Lavender Street and Jalan Besar. They do not occur in the very large market garden area behind Moulmein Road and Balestier Road, but some may be found in certain gardens just off Lavender Street and Jalan Besar. The snails also occur in smaller numbers along Scotts Road, Oxley Road, River Valley Road and Kramat Road, while they are very numerous in the triangle of land now occupied by dhobi houses, but formerly a rubbish dump, that lies between Killiney Road, Devonshire Road and Paya Lane. Giant Snails have also been found at Katong in hibiscus hedges of the compounds of houses near the Sea View Hotel.

The Sub-Inspector of Agriculture who has worked for many years in Singapore, both in the Botanic Gardens and in the Department of Agriculture, states that fifteen years ago he used to see these snails in the Botanic Gardens and elsewhere and that another Malay Officer in the Gardens remembers this. If this is correct, it indicates that the snails may have been introduced with living plants from abroad, or possibly from Kedah.

DESCRIPTION AND HABITS.

Achatina fulica has a shell which in average local specimens is between 4 and 5 inches long, though occasionally examples may be found as much as 6½ inches long. The greatest width is between 1½ and 2 inches. The large, lowest whorl of the shell is of a chestnut brown colour with longitudinal bands of light brown or yellow. The next whorl above passes from wavy bands of yellow and chestnut brown to olive green striped with chestnut brown. The upper whorls are olive green striped with narrow brown longitudinal bands and often tinged with pink towards the apex.

The snails probably take two years to attain their full size, but are capable of laying eggs at the end of the first

year when half grown. So far as is known at present, the eggs are laid only once a year, in Ceylon during wet weather (1 and 4) and in India in June and July (1 p. 62). A number of pockets of eggs were found recently in Singapore by the writer during June. In Ceylon and India the half grown snail lays about 100 eggs in a pocket and the full grown snail from 200 to 300. The recent observations in Singapore confirm these figures. Each individual is bisexual, as is usual in the snail family, but pairing may be necessary to produce fertile eggs.

The eggs are about the size of a large pea. They are round and yellow, with a hard shell like that of a bird's egg. Batches of eggs are laid in shallow pockets just below the surface of loose soil in sheltered places. Thus they can be found in soil at the foot of trees, under hedges, below rank vegetation, under large stones, broken bricks and crockery or old ironware, or in heaps of vegetable refuse or manure. Hutson (4) states that under favourable conditions they may hatch within two or three weeks after being deposited. There are indications that they hatch more quickly in Singapore, and that the moisture of the surroundings influences the interval between deposition and hatching.

The young snails are about the same size as the eggs and emerge with their own body shells fully formed. They feed voraciously at an early age and are quite inconspicuous for the first month at least. Among batches of hatching eggs examined in Singapore a number of empty shells of the newly emerged snails were found. This indicates that the very young snails are attacked by natural enemies, probably insects and in particular ants. Green (1 p. 60) observed a species of predacious ant (*Phidelogeton affinis*) swarming on batches of eggs that were just hatching and considered this insect likely to be a valuable agent in the reduction of the broods. As the snails develop a number must die from natural causes, otherwise the increase in their numbers would have been far more rapid than it has been observed to be in Malaya.

The older snails feed for the most part on decaying vegetable and animal matter, though they also eat various ornamental plants and vegetables. In this connection the Agricultural Field Officer, Perak North, Mr. Birkinshaw, records that the snails did considerable damage to plants in his garden in Taiping during the dry months of January, February and March of this year. During these months his gardener attempted to establish a bed of *Gynandropsis speciosa*, but failed, owing to the depredations of the snails, although he killed large numbers every evening and early morning. In May, when more rain fell, a bed of these plants was successfully established and the snails gave much less trouble. In June Mr. Birkinshaw went round his garden one evening and after careful search found three snails.

One was feeding on the dead leaf of a *Hippeastrum*, another on the dead and decaying leaf of a *Bignonia* and the third on dead grass used as a mulch. Possibly in dry weather decaying vegetable matter becomes too dry for the snails which then attack living plants. It is the general opinion in Taiping that the snails have not interfered much with growing plants since the weather became wetter. In Singapore during showery weather in June, the snails were found in very large numbers in hedges, especially of hibiscus, but very little damage to the living foliage was observed.

The Giant Snails feed mostly at night and in the early morning. During the heat of the day they rest, usually in sheltered places, as for example under hedges, under thick vegetation, under trees and in rubbish heaps. Where they are numerous, they are also to be found resting on the trunks of trees, the stems and branches of hedge plants, the sides of drains, or the walls of houses. They can then be easily collected and destroyed. They crawl onto whitewashed or plastered walls to obtain the lime necessary to build their shells.

In Ceylon according to Hutson (4) the Giant Snail is active only in the wet weather; it retires during dry weather to sheltered places, closing up the mouth of its shell with a parchment-like cover, the hibernaculum, which it can secrete as required. Green (1 p. 61) states that it has the same habit in Mauritius. In the even climate of Malaya it appears to be active for the greater part of the year in suitable localities, so far as observations go up to the present, though resting snails were found in rather dry situations in Singapore during June after a long spell of dry weather.

NATURAL ENEMIES.

The definitely recorded natural enemies of *Achatina fulica* are not very numerous. Hutson (4) records information that wild pig will eat the snails in the jungle and that the "Jungle crow" (*Centropus chlororhynchus*) is very fond of them in some localities in Ceylon. Ducks and fowls will also eat the young snails. Green (1 p. 59) considers it probable that the minute newly hatched snails will be devoured by various birds and carnivorous insects and records the association of the ant, *Phidelogeton affinis*, with batches of eggs just hatching. Hutson considered the larva of a "glow-worm" or "fire-fly", *Lamprophorus tenebrosus*, as the most important insect enemy of the Giant Snail in Ceylon in 1920. This insect also occurs in Malaya. Anrandale (3) states that *Achatina fulica* in Calcutta appears to be subject occasionally to some kind of fatal epidemic and also perishes in large numbers after egg-laying at the beginning of the rainy season and during dry spells in and at the end of that season. In the Killiney Road locality in Singapore.

a number of empty shells and of dead or dying snails were found in June last and it appeared as if some form of disease had attacked these snails. Observations on the natural enemies of the Giant Snail will be continued, as little is at present known about these in Malaya.

STATUS AS A PEST.

The experience of different countries regarding the actual damage to cultivated crops caused by the Giant Snail appears to vary considerably.

Green (1 p. 61) was informed by Mr. G. O. Barnard, who had spent many years in Mauritius, that in that country no particular notice is taken of its presence. "The young snails are sometimes troublesome in vegetable gardens, but are kept in check by hand picking. Their value as scavengers is recognised." This opinion is confirmed by the Agricultural Field Officer, Perak North, Mr. Birkinshaw, who, throughout his stay in Mauritius, was in close touch with all the large number of small holders who grew excellent vegetables, and also had a good vegetable garden of his own. Had the snail done any serious damage, he would have known of it.

Annandale (3) writing of this snail in India says:— "Fortunately, it is largely a feeder on decaying vegetable and animal matter and therefore does little harm to crops or gardens, and has even its value as a scavenger." He records, however, that the dead bodies of the snails serve as breeding places for the maggots of the blue-bottle fly which increases rapidly in numbers when there is a heavy mortality among the snails. In a large tropical town this point might be a matter of importance on account of the danger from fly-borne human diseases. I have up to the present been unable to find any references to this snail as even a minor pest in India.

In Ceylon Hutson (4) summarises the position in 1920 as follows:—

"Since 1910 the African snail appears to have increased its range of food plants during its spread over a much wider area, but even at the present time it is not known to do any serious damage to any of the chief crops of the island, such as tea, rubber, coconuts, cacao and paddy. The snails are, however, a pest of vegetable gardens in most localities below an elevation of about 3,000 feet.

"The following notes will serve to indicate the status of *Achatina* in relation to the staple crops of the island, but these statements may be subject to modification when more is known about the feeding habits of the snails at different elevations.

"*Tea*.—The African snail is not known to attack tea, although individual specimens are occasionally seen on the bushes.

Young dadaps (*Erythrina*) are sometimes girdled and killed by them, while the older dadaps suffer a partial loss of bark and leaves as a result of their attacks.

"*Rubber*.—The Department of Agriculture has from time to time received reports that *Achatina* has been seen drinking rubber latex at tapping time, and these snails undoubtedly do so, but at present the evidence is not sufficient to show that they cause any serious loss to this crop.

"*Coconuts*.—While the snails sometimes swarm on coconut palms, and even over the fronds of young coconut plants, we have never received any report that they injure the plants in any way.

"*Cacao*.—These snails sometimes kill off young supply plants, while the blossom of bearing trees is occasionally injured by them. Measures are now being taken on some estates to protect young plants.

"*Paddy*.—*Achatina fulica* is not known to attack paddy plants, although it occasionally swarms over the fields and bends down the plants by weight of numbers.

"*Vegetable Crops*.—Here the African snail is undoubtedly a pest and in some localities the growing of certain vegetables has become almost impracticable owing to its ravages. The snails, however, can be controlled by carrying out the measures suggested elsewhere.

"*Fruits Trees*, sometimes injured by snails, can be protected by banding."

In a letter to the "Straits Times" reproduced in the "Malay Mail" of March 24th last, Mr. G. B. W. Grey attributes to this pest considerably greater damage to two of the important crops in Ceylon, rubber and cacao. He writes:—

"In 1916 I happened to be in Ceylon and saw with my own eyes the terrible damage these pests were doing, despite mighty efforts of the inhabitants to exterminate them. They effectively destroyed the whole of the vegetable gardens in the Dumbara valley, and at one time it became impossible to plant up new clearings of cocoa and rubber and they even attacked the bark of the full grown "Dadup" and ornamental trees."

This account of the damage to rubber and cacao is supported by editorials in the "Malay Mail" of March 16th and June 30th of this year.

Enquiries have been made as to the present status of the Giant Snail as a pest in Ceylon and Mauritius, but no information has yet been received.

In Malaya, before the beginning of this year, the Giant Snail did so little damage in the few localities where it was present, that it did not attract any attention until the year 1922. Even then the interest evinced was confined to the owners of the few gardens where the snails were somewhat numerous and damaged ornamental plants, to a few scientific collectors and agricultural officers. In the last five years during which the Giant Snails have been under observation they have not increased greatly in numbers, except in Singapore, where, particularly in the last twelve months, they have become very numerous in certain localities. Their depredations up to the present have been almost entirely confined to private flower gardens where they have at times damaged ornamental plants. Even this year's investigations in Singapore have not revealed damage of any importance. In localities where the snails were very numerous, as for example in certain hibiscus hedges along Thompson Road and Moulmein Road, there was no noticeable harm done to the vegetation and, on close examination, leaves could only be found here and there on which the snails had been feeding. The great majority of the Chinese vegetable gardeners reported no damage from these snails. Some reported a little damage, but these were mostly the owners of gardens near grassy banks, waste land or patches of land planted with fruit trees, bananas and the like, in which the snails were able to shelter in large numbers. Most of these gardens were situated close to Lavender Street and Jalan Besar. In a few instances, where the gardens were immediately adjoining grassy banks or other sheltered places in which the snails could congregate during the day, the gardeners said that the snails did damage, and that they had to go out at night and collect them. In the great majority of cases, however, the Chinese took no measures to destroy the snails, as these industrious people certainly would have done, had their vegetables suffered to any appreciable extent.

At present, therefore, the snails are of little actual importance. The danger is that they may increase rapidly and then cause damage, especially to vegetable gardens, by sheer weight of numbers, being compelled to eat larger quantities of living plants through lack of sufficient food in other forms. The position, especially in Singapore, is receiving attention. The officers of the Agricultural Department are keeping under observation all places where the presence of the snail is known, and will take steps to control

it in any locality where it appears to be increasing at all rapidly.

CONTROL MEASURES.

The control measures recommended by Dr. Hutson in Ceylon are equally applicable in Malaya, they comprise the following.

1. Collection and destruction of the snails in all stages, wherever these are found.
2. The use of specially prepared "traps" for snails and the periodical treatment of such traps.
3. The use of wood ashes or saw-dust, with or without copper sulphate, to protect vegetable gardens.
4. The use of copper sulphate in solution in various strengths for treating snails.
5. Clean weeding.

1. COLLECTION AND DESTRUCTION.

This is a general method applicable wherever the snails occur. The snails can be collected in bags or sacks in the morning or evening. When collected they can be crushed in the sacks and buried, or be buried in pits without crushing and covered with about 18 inches of well stamped earth; or they can be put into boiling water, a solution of salt, or of copper sulphate and then be buried, or burnt in incinerators.

A careful search should also be made for breeding places of the snails in the places already indicated and all eggs found should be destroyed.

2. TRAPS.

Trap heaps of stones, bricks, rubbish, decaying fruits or other vegetable refuse can be constructed in places where snails are numerous. The traps can be visited periodically and the snails destroyed. The traps can, if necessary, be renewed from time to time.

3. WOOD ASHES OR SAWDUST.

Vegetable or flower beds can be protected by surrounding them with shallow trenches filled with wood ashes or sawdust, renewed at intervals. This method was used successfully in gardens at Butterworth. The wood ashes or sawdust can be rendered even more effective by steeping them in a 10 per cent solution of copper sulphate for several hours and then putting them in shallow trenches, or sprinkling them over a wall of stones. If the dust used is steeped thoroughly

in the solution, it retains its effectiveness for some time, but requires renewal after heavy rain.

4. COPPER SULPHATE SOLUTION.

Even a weak solution has a very caustic effect on these snails. For killing large numbers collected a 4 per cent solution is effective, the snails being immersed for 5 minutes. To make this, 2 lbs. of Copper sulphate are dissolved in about 5 gallons of water in a wooden, copper or earthenware vessel. Tin and iron vessels must not be used as they decompose the copper sulphate.

By having a series of wooden tubs at different levels the solution can be run off from one to another, as the vessels become filled with snails. The treated snails can be buried or spread over breeding places to kill other snails. The used liquid can be stored from day to day in covered wooden vessels and more can be added, as required, to make up the quantity and strength desired.

A ten per cent solution is made by dissolving 1 lb. of copper sulphate crystals in one gallon of hot water. This can be used to water heaps of snails, or places where snails collect. Vegetable beds can be surrounded with walls of stones which are watered two or three times a week with this solution. It can also be used, as described, with wood ashes or saw-dust to protect vegetable beds. The soaked dust can also be sprinkled into places where the snails hide.

Coir rope, soaked for 24 hours in a 10 per cent solution of copper sulphate, can be used to protect plants. It can be pegged down round vegetable beds, so as to touch the soil at all points, and can also be used for banding fruit trees as a barrier against climbing snails. If the rope is well soaked it retains its effectiveness for sometime, but can be resoaked periodically.

Much could be done to control the Giant Snails, if every one would collect and destroy them in all private gardens where they are numerous. The public can also assist the Department in guarding against the danger of a rapid increase in their numbers by informing the Chief Agricultural Field Officer, Department of Agriculture, Kuala Lumpur, of places where they are to be found, more especially of places where they have not yet been recorded.

Neither the damage done by the Giant Snail nor its numbers have, up to the present, justified the cost of any extensive and organised control measures, but these will be undertaken when required. Any attempt to eradicate this snail entirely from the places where it has obtained a footing offers very little prospect of success, and it seems highly questionable if the cost of the attempt would ever be justified by the damage done.

REFERENCES.

1. Green, E.E., Circs. and Agr. Journal of the Royal Botanic Gardens Ceylon, Vol. V, No. 7, 1910.
2. Godwin-Austen, Col., Proc. Mal. Soc. Vol. VIII, p. 147, 1908.
3. Annandale, Dr. N., Nature, Vol. CIV, p. 413, 1919.
4. Hutson, Dr. J.C., Trop. Agric., Vol. LV, p. 217, 1920.
5. Cribb, C.T., "Straits Times" March 13th, 1926.
6. Jarrett, V.H.C., Singapore Naturalist, April 1923. p. 73.
7. South, F.W., Malayan Agric. Journal Vol. X, p. 267, 1922.
8. South, F.W., Malayan Agric. Journal Vol. IX, p. 253, 1923.
9. South, F.W., Malayan Agric. Journal Vol. XII, p. 36, 1924.
10. South, F.W., Malayan Agric. Journal Vol. XII, p. 229, 1924.
11. South, F.W., Malayan Agric. Journal Vol. XIII, p. 201, 1925.

Received for publication 15.6.26.

Publications of the Department of Agriculture.

The following publications, except those out of print, may be obtained on application to the Office of the Secretary for Agriculture; and the Malay States Information Agency, 88, Cannon Street, E.C. London.

A remittance to cover the cost should accompany applications; otherwise the Journals will be sent by post, Cash on Delivery, where that system is in force.

1. The Agricultural Bulletin F.M.S.

Vols. I—IV (1913-16) VIII & IX (1920-21) price \$5.00 per volume.

Vol. V (1917) Nos. 1, 2, 3, 5 & 6 „ 250 per set.

„ VII (1919) „ 2—6 „ 450 „

(Vol. VI is out of print.)

2. The Malayan Agricultural Journal (continuing the Agricultural Bulletin) Published monthly.

Vol. X (1922) Price \$5.00 per volume.

„ XI (1923) Price \$5.00 per volume or 50 cents per single number.

„ XII (1924) „ „ „ „

Back numbers of Vols. I—X will not be sold singly.

3. The Handbook of Malayan Agriculture, price \$1.00.

Current numbers of the Malayan Agricultural Journal and the Handbook may be purchased from the Railway Bookstalls and Branches of Messrs. The Federal Rubber Stamp Co.

4. Special Bulletins.

1. Notes on *Termes Gestroi* and other species of Termites found on Rubber Estates in the Federated Malay States, by H. C. Pratt, 1909, 20 cts.
2. Root Diseases of *Hevea Brasiliensis*, by W. J. Gallagher.
3. Observations on *Termes Gestroi* as affecting the Para Rubber Tree and methods to be employed against its Ravages, by H. C. Pratt, 1910, 20 cts.
4. *Brachartona catoxantha*, Hamps, by H. C. Pratt, 1909.
5. The Extermination of Rats in Rice Fields, by W. J. Gallagher, 1909.
6. Branch and Stem Disease of *Hevea Brasilienisis*, by W. J. Gallagher, 1909.
7. *Coffea Robusta*, by W. J. Gallagher, Government Mycologist, 1910, 20 cts.
8. The Cultivation and Care of the Para Rubber Tree (in Malay) 1910.
9. Die-Back Fungus of Para Rubber and of Cacao, by K. Bancroft, 1911.
10. A Lecture on the Para Rubber Tree, by W. J. Gallagher, 1910.
11. Coconut Cultivation, by L. C. Brown, 1911
12. Padi Cultivation in Krian, by H. C. Pratt, 1911
13. A Root Disease of Para Rubber, *Fomes Semitostus*, by K. Bancroft, 1912, 20 cts.

C = Cancelled

**MAP OF
BRITISH MALAYA
SHOWING DISTRIBUTION
OF
AGRICULTURAL STAFF,
PLANTATIONS & RESERVES**

LEGEND:

- TAIPING
- Kojang
- SERDANG
- Kuantan

Headquarters of European Officers

Govt. Experimental Plantations

Proposed Departmental Reserves

Geographical Labels: S I A M, KEDAH, PERAK, KELANTAN, TRENGGANU, PAHANG, SELANGOR, NEGRI SEMBILAN, JOHORE, KUALA LUMPUR, KUALA KANGSAR, BUTTERWORTH, TITI SERONG, PONDOK TANJONG, KUALA KANGSAR, BATU GAJAH, CAMERON'S PLATEAU, TELUK ANSON, CASTLETON ESTATE, RAUB, TANJONG MALIM, KUALA KUBU, TEMERLOH, KUALA SELANGOR, KLANG, SERDANG, AYER KRING, KUALA PILAH, REMBANG, GEMENCHAH, SEGAMAI, ALOR GAJAH, JASIN, MALACCA, PANCHOR, MINAR, BATU PAHAT, KOTA TINGGI, JOHORE BHARU, SINGAPORE, KINLORE, KUALA LUMPUR, HEADQUARTERS DEPT. OF AGRICULT. F. M. S. & S. I.

DRAWN & PRINTED BY F. M. S. SURVEYS NO. 49 - 1926.

